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AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the applications.

LISTING OF CLAIMS

1. (currently amended) A merged dual flipped White Cell including:

(a) a dual White Cell having first and second cell regions;

(b) an optical deflector array for selectively deflecting light to either a first image plane associated with said first region or to a second image plane associated with said second region;

(c) a plurality of guided-wave optical delay lines, each of said delay lines having an input portion for receiving light at said first image plane and a separate output portion for returning delayed light at said first image plane, said input portion and separate output portion including waveguide sections that are tilted with respect to the first image plane; and

(d) a plurality of reference mirrors and separate guided-wave optical input and output ports in optical communication with said optical deflector array and with said plurality of delay lines.

2. (original) The merged dual flipped White Cell of claim 1 wherein the plurality of optical delay lines has a plurality of ports and wherein the White Cell includes a light refractive element for imaging light onto the optical deflector array, the plurality of ports for the plurality of optical delay lines, the plurality of reference

mirrors and the plurality of optical input and output ports.

3. (original) The merged dual flipped White Cell of claim 2 wherein the optical deflector array includes an array of optical path switching devices for selectively adjusting light-reflective surfaces so as to selectively deflect light to either said first image plane associated with said first region of said White Cell or to said second image plane associated with said second region of said white cell.

4. (original) The merged dual flipped White Cell of claim 3 wherein the array of optical path switching devices includes an array of MEM devices for selectively moving the light-reflective surfaces so as to selectively deflect light to either said first image plane associated with said first region of said White Cell or to said second image plane associated with said second region of said white cell.

5. (original) The merged dual flipped White Cell of claim 3 wherein the optical deflector array includes MEM devices for moving associated mirrored surfaces, the MEM devices each being responsive to an electrical voltage or current for controlling the associated mirrored surface.

6. (original) The merged dual flipped White Cell of claim 3 wherein the first image plane and the second image plane are co-planar.

7. (original) The merged dual flipped White Cell of claim 1 wherein the reference mirrors reflect light back to the optical deflector array.

8. (original) The merged dual flipped White Cell of claim 7 wherein the reference

mirrors provide a reference time delay.

9. (original) The merged dual flipped White Cell of claim 1 wherein the White Cell includes four convex mirrored surfaces for reflecting light (i) to and from the first image plane and the optical deflector array and (ii) to and from the second image plane and the optical deflector array.

10. (canceled)

11. (original) The merged dual flipped White Cell of claim 1 wherein the input and output ports contain waveguide sections that are tilted with respect to the second image plane.

12. (original) The merged dual flipped White Cell of claim 1 wherein the plurality of optical delay lines each produce a distinct time delay.

13. (original) The merged dual flipped White Cell of claim 12 wherein each of the distinct time delays of the plurality of optical delay lines is associated with a time delay for steering the beam of an antenna array.

14. (original) The merged dual flipped White Cell of claim 1 wherein the optical delay lines are implemented at least in part by waveguides in at least one substrate.

15. (original) The merged dual flipped White Cell of claim 14 wherein the optical delay lines further comprise optical fibers in optical communication with at least

selected ones of said waveguides.

16. (original) The merged dual flipped White Cell of claim 15 wherein a plurality of said substrates are arranged with endfaces thereof disposed in a planar array defining said first image plane.

17. (original) The merged dual flipped White Cell of claim 1 wherein the input and output ports are provided by waveguides in at least one substrate.

18. (original) The merged dual flipped White Cell of claim 17 wherein a plurality of said substrates are arranged with endfaces thereof disposed in a planar array defining said second image plane.

19. (original) The merged dual flipped White Cell of claim 18 wherein the second image plane comprises a two dimensional array of images associated with a two dimensional array of input and output ports.

20. (original) A wavelength tapped delay White Cell comprising: a White Cell optical cavity having a flat mirror plane on a first side thereof and curved mirrors on a second side thereof, the flat mirror plane having an array of frequency-selective taps.

21. (original) The wavelength tapped delay White Cell of claim 20 wherein the array of frequency-selective taps comprises an array of frequency-selective filters disposed on said flat mirror plane.

22. (original) The wavelength tapped delay White Cell of claim 21 wherein the array of frequency-selective filters comprises an array of Fabry-Perot frequency-selective filters that transmit light of one or more selected frequencies and reflect the light of other non-selected frequencies.

23. (original) The wavelength tapped delay White Cell of claim 20 further including an input/output mirror for receiving light or supplying light to one of the curved mirrors on the second side of the White Cell cavity.

24. (original) The wavelength tapped delay White Cell of claim 20 further including at least one multiplexing port light-coupled to a subset of the frequency selective taps, the subset being associated with said at least one multiplexing port.

25. (original) The wavelength tapped delay White Cell of claim 20 wherein the array of frequency-selective taps is a two dimensional array.

26. (original) The wavelength tapped delay White Cell of claim 25 wherein selected ones of the frequency-selective taps in the two dimensional array receive incoming light from a common modulator, said selected ones being arranged diagonally through the two dimensional array of frequency-selective taps.

27. (original) The wavelength tapped delay White Cell of claim 25 wherein selected ones of the frequency-selective taps in the two dimensional array provide light to a set of photodetectors, said selected ones being arranged diagonally through the two dimensional array of frequency-selective taps.

28. (original) The wavelength tapped delay White Cell of claim 25 wherein selected ones of the frequency-selective taps in the two dimensional array receive incoming light from a common modulator through a multiplexing port, said selected ones being arranged parallel to a major axis of the two dimensional array of frequency-selective taps.

29. (original) The wavelength tapped delay White Cell of claim 25 wherein selected ones of the frequency-selective taps in the two dimensional array provide light to a common photodetector through a multiplexing port, said selected ones being arranged parallel to a major axis of the two dimensional array of frequency-selective taps.

30. (original) An antenna beamformer system comprising one or more wavelength tapped White Cells according to claim 20, optical modulators connected to an input of one of the one or more wavelength tapped White Cells and a plurality of photodetectors coupled to the frequency selected taps.

31. (original) The antenna beamformer system of claim 30 wherein the switched path delay lines are provided by one or more Merged Dual Flipped White Cells, the Merged Dual Flipped White Cells comprising:

(a) a dual White Cell having first and second cell regions;

(b) an optical deflector array for selectively deflecting light to either a first image plane associated with said first region or to a second image plane associated with said second region;

(c) a plurality of guided-wave optical delay lines, each of said delay lines

having an input portion for receiving light at said first image plane and a separate output portion for returning delayed light at said first image plane; and

(d) a plurality of reference mirrors and separate guided-wave optical input and output ports in optical communication with said optical deflector array and with said plurality of delay lines.

32. (original) The antenna beamformer system of claim 30 further including switched path delay lines disposed between the plurality of photodetectors and the optical modulators and wherein light at different wavelengths undergoes either different amounts of delay or a common amount of delay in the switched path delay lines.

33. (original) The antenna beamformer system of claim 30 further including an array of antenna elements coupled to said optical modulators.

34. (original) The antenna beamformer system of claim 30 wherein light from a single wavelength source is coupled to said optical modulators.

35. (original) The antenna beamformer system of claim 30 wherein light from sources at multiple wavelengths is coupled to said optical modulators.

36. (original) The antenna beamformer system of claim 35 wherein light at multiple wavelengths are combined in single ones of said plurality of photodetectors.

37. (original) An antenna beamformer system comprising one or more

wavelength tapped White Cells according to claim 20, photodetectors connected at an input of one of the one or more wavelength tapped White Cells and optical modulators coupled to the frequency selected taps.

38.(original) The antenna beamformer system of claim 37 wherein light from a single wavelength source is coupled to said optical modulators.

39. (original) The antenna beamformer system of claim 37 wherein light from sources at multiple wavelengths is coupled to said optical modulators.

40.(original) The antenna beamformer system of claim 39 wherein light at multiple wavelengths is combined in single ones of said plurality of photodetectors.

41. (original) The antenna beamformer system of claim 37 further including switched path delay lines disposed between at least one photodetector and the optical modulators and wherein light at different wavelengths undergoes either different amounts of delay or a common amount of delay in the switched path delay lines.

42. (original) The antenna beamformer system of claim 37 wherein the switched path delay lines are provided by one or more Merged Dual Flipped White Cells, the Merged Dual Flipped White Cells comprising:

(a) a dual White Cell having first and second cell regions;

(b) an optical deflector array for selectively deflecting light to either a first image plane associated with said first region or to a second image plane

associated with said second region;

(c) a plurality of guided-wave optical delay lines, each of said delay lines having an input portion for receiving light at said first image plane and a separate output portion for returning delayed light at said first image plane; and

(d) a plurality of reference mirrors and separate guided-wave optical input and output ports in optical communication with said optical deflector array and with said plurality of delay lines.

43. (original) A method of forming and/or detecting a radio frequency beam at an antenna array, the method comprising:

applying light waves of a single wavelength or of a plurality of discrete wavelengths to at least one optical modulator coupled to at least one wavelength tapped delay White Cell, wherein the at least one wavelength tapped delay White Cell has a White Cell optical cavity with a flat mirror plane on a first side thereof and curved mirrors on a second side thereof, the flat mirror plane having an array of frequency-selective taps;

applying RF signals to said at least one optical modulator and generating RF modulated light waves that are coupled to said at least one wavelength tapped delay White Cell, whereby said at least one wavelength tapped delay White Cell generates a plurality of time-delayed RF modulated light waves in response thereto; and

coupling the plurality of time-delayed RF modulated light waves to at least one photodetector coupled to the said at least one wavelength tapped delay White Cell.

44. (original) The method of claim 43 wherein the radio frequency beam is

received at the antenna array and wherein the RF signals applied to said at least one optical modulator are obtained from the antenna array.

45. (original) The method of claim 43 wherein the radio frequency beam is transmitted at the antenna array, wherein the RF signals applied to said at least one optical modulator are obtained from at least one transmitter waveform generator and wherein a signal output by the at least one photodetector is coupled to the antenna array.

46. (original) The method of claim 43 wherein a plurality of light waves each of a discrete wavelength are coupled to different ones of the array of frequency-selective taps.

47. (original) The method of claim 43 wherein the at least one wavelength tapped delay White Cell includes an input/output mirror for receiving light or supplying light to one of the curved mirrors on the second side of the White Cell cavity and wherein the input/output mirror has at least one multiplexing port light-coupled to a subset of the frequency selective taps, the subset being associated with said at least one multiplexing port.

48. (original) The method of claim 47 wherein the light of multiple wavelengths is coupled to or from each of the at least one multiplexing port.

49. (original) The method of claim 48 wherein each of said at least one multiplexing port is coupled to a photodetector, said photodetector combining the multiple time-delayed RF modulated light waves to produce a RF signal

associated with a particular antenna beam direction.

50. (original) The method of claim 46 wherein different ones of the time-delayed RF modulated light waves are coupled to different ones of the frequency selective taps, said different ones of the frequency selective taps being connected to different photodetectors, the different photodetectors generating different time-delayed RF signals.

51. (currently amended) The method of claim [[51]] 50 further including combining the different time-delayed RF signals to produce a RF signal associated with a particular antenna beam direction.

52. (original) The method of claim 43 further including coupling said at least one wavelength tapped delay White Cell to at least one merged dual flipped White Cell, the merged dual flipped White Cell including a dual White Cell with first and second cell regions, an optical deflector array for selectively deflecting light to either a first image plane associated with said first region or to a second image plane associated with said second region, a plurality of guided-wave optical delay lines, each of said delay lines having an input portion for receiving light at said first image plane and a separate output portion for returning delayed light at said first image plane, and a plurality of reference mirrors and separate guided-wave optical input and output ports in optical communication with said optical deflector array and with said plurality of delay lines, said at least one merged dual flipped White Cell being located between said at least one optical modulator and said at least one photodetector.

53. (currently amended) A method of forming and/or detecting a radio frequency beam at an antenna array, the method comprising:

applying light waves of a single wavelength or of a plurality of discrete wavelengths to at least one merged dual flipped White Cell, the merged dual flipped White Cell including a dual White Cell with first and second cell regions, an optical deflector array for selectively deflecting light to either a first image plane associated with said first region or to a second image plane associated with said second region, a plurality of guided-wave optical delay lines, each of said delay lines having an input portion for receiving light at said first image plane and a separate output portion for returning delayed light at said first image plane, said input portion and separate output portion including waveguide sections that are tilted with respect to the first image plane, and a plurality of reference mirrors and separate guided-wave optical input and output ports in optical communication with said optical deflector array and with said plurality of delay lines;

applying RF signals to said at least one optical modulator and generating RF modulated light waves that are coupled to said at least one merged dual flipped White Cell, whereby said at least one merged dual flipped White Cell generates a plurality of time-delayed RF modulated light waves in response thereto; and

coupling the plurality of time-delayed RF modulated light waves to at least one photodetector coupled to the said at least one merged dual flipped White Cell.

54. (original) The method of claim 53 wherein the radio frequency beam is received at the antenna array and wherein the RF signals applied to said at least

one optical modulator are obtained from the antenna array.

55. (original) The method of claim 53 wherein the radio frequency beam is transmitted at the antenna array, wherein the RE signals applied to said at least one optical modulator are obtained from at least one transmitter waveform generator and wherein a signal output by the at least one photodetector is coupled to the antenna array.

56. (original) The method of claim 53 further including operating the deflector array to select different subsets of the plurality guided-wave optical delay lines and plurality of reference mirrors to generate different combinations of time-delayed RE modulated light waves.

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